

RECENT EVIDENCE ON IMPROVED INVENTORY CONTROL: A QUARTERLY MODEL OF THE U.S. ECONOMY FOR THE PERIOD 1959-2001

Sweidan, Osama D.*

Abstract

This Paper aimed to re-test the hypothesis whether the improved inventory control affects the inventory investment or not. This paper used Bechter and Stanley (1992) model. The contribution of this letter has two dimensions; first, this paper extends the time horizon by using a quarterly data of the U.S. economy for the period 1959-2001. Also, it modifies Bechter and Stanley model under certain assumption and use the adjusted model to re-exam the hypothesis. The results of the paper support the idea that improved inventory control has a significant impact on the behavior of inventory investment. In addition, it shows that the improvement vary from one sector to another. Further, the paper showed that the speed of adjustment will be faster if the firms ignore holding inventories as a buffer stock.

JEL Classification: C50, E0

Keywords: Real private inventories, Just-In-Time Inventory (JIT).

1. Introduction

“If a man from Mars visited this planet and spent a year or so reading all the macroeconomic literature of the past 15-20 years, he would not come away feeling that inventories are of much importance. If we then give him five minutes with the National Income and Product Accounts of the United States, he would quickly conclude that there was something lacking in his education. Inventories are important.” (Blinder,1990, p.10).

* Osama D. Sweidan, Ph.D Department of Economics.P.O. Box 150459.The Hashemite University, Zarqa, Jordan. e-mail: osweidan@hu.edu.jo
osweidan@lamar.colostate.edu

There is no doubt that inventory investment plays a crucial role in the business cycle. Quarterly data during the period 1947-2001 from the United States economy shows that despite the fact that change in inventories is a tiny portion of GDP, averaging roughly 0.51 percent of real GDP, but the fluctuations in change in inventory are not small relative to the fluctuations in GDP. In Addition, the data shows that the volatility of change in inventory as a percentage of GDP, on average, is roughly 64 percent¹.

Table 1 shows the decline in real GDP from peak to trough in the postwar recessions and the corresponding decline in inventory investment for the same period. Table 1 demonstrates that in many quarters, the fall in inventory investment dominated the fall in real GDP, and this means a strong relationship exists between those two macroeconomic variables.

Table 1. Changes in real GDP and real private inventories during the period 1948-2001²

Peak to trough	Change in RGDP ^(*) (1)	Change in inventory investment ^(*) (2)	The Ratio = (2)/ (1) (%)
1948.4 – 1949.	-24.9	-36.3	145.8
1953.2 – 1954.	-51.2	-21.6	42.2
1957.3 – 1958.	-81.5	-18.3	22.5
1960.1 – 1960.	-38.1	-50.4	132.3
1969.3 – 1970.	-21.8	-43.6	200.0
1973.4 – 1975.	-141.1	-62.7	44.4
1980.1 – 1980.	-108.6	-54.1	49.8
1981.3 – 1982.	-144.7	-45.6	31.5
1990.2 – 1991.	-100.3	-51.8	51.6
2000.4 – 2001.	-57.4	-121.7	212.0

(*): Data are in billions of chained 1996 dollars

¹Following Christiano's (1988) methodology.

²Blinder (1990), Blinder and Maccini (1991) and Fitzgerald (1997) used this table.

Source: Estimated by the researcher

On average, Table 1 shows that the drop in real private inventory investment has accounted for 93 percent of the drop in real GDP³. Therefore some economists say that understanding movements in the inventories is a necessary condition to understanding the business cycle or inventory fluctuations provide important information about cyclical fluctuations in GDP. Blinder (1990) said that business cycles are, to a surprisingly large degree, inventory cycles.

In a recent study, Stock and Watson (2002) have a number of explanations for the decline in the business cycle volatility. Specifically, some previous studies focused on the assessment of the effect of improved inventory control on inventory investment i.e. Morgan (1991), Bechter and Stanley (1992), Little (1992), Huh (1994), Allen (1995), Filardo (1995) and McCarthy and Zakrajsek (2003). The results of these studies were mixed. These studies tried to prove that inventory control methods i.e. just-in-time (JIT) inventory could alter (moderate) aggregate inventory cycle which mutes the business cycle.

The goal of the current paper is to contribute in a debatable issue by re-testing the hypothesis of improved inventory control by using Bechter and Stanley (1992) model. The contribution of this paper has two dimensions; first, this paper extends the time horizon by using a quarterly data of the U.S. economy for the period 1959-2001. This paper relies on the economagic web site as a main source for the data. Second, this paper modifies Bechter and Stanley model under certain assumption and use the adjusted model to re-exam the hypothesis.

The paper is organized as follows: Section 2 presents a literature review. Section 3 introduces Bechter and Stanley (1992) model. Section 4 introduces the adjusted model. Section 5 summarizes the results of the regression models. Conclusions are made in section 6.

³Blinder and Maccini (1991) reported approximately the same result, which is 87 percent.

2. Literature Review

The relationship between inventory management and inventory investment in the U.S. economy is still a debatable issue among the economists. Filardo (1995)⁴ stated that the statistical tests fail to reveal a structural change in the relationship between inventory investment and the business cycle. This implies that inventory management has no effect on the behavior of inventory investment. Huh (1994) said that the evidence is not as clear as other economists claim.

Morgan (1991), Little (1992), Allen (1995) found that the new inventory management has a significant structural change in the economy which implies an important effect on inventory investment behavior. Bechter and Stanley (1992) proved that the improved inventory control happened in specific sectors such as finished goods and materials and work in progress⁵. Stock and Watson (2002) do not agree that inventory management plays a crucial role in business cycle volatility. McCarthy and Zakrajsek (2003) proved that the manufacturing inventory dynamics have changed since mid of 1980s.

Theoretically, the relation between aggregate inventory cycles and business cycle is direct i.e. Table 1. Changing the amplitude of the inventory cycle or changing its timing affects the business cycle in the same direction. But, as long as we are not quite sure about the change in the inventory cycles then the effect on the business cycle is ambiguous.

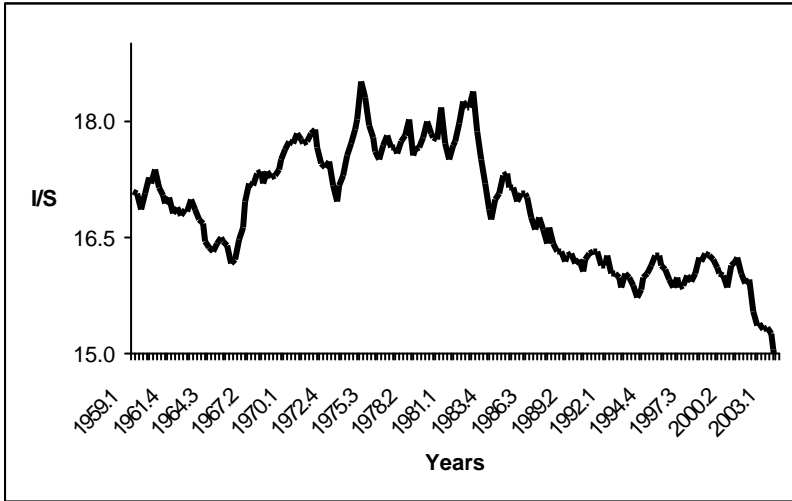
Chart 1 shows a decline in the aggregate inventory-sales ratio at the beginning of 1980s. Some economists relies on such evidence to support the idea of improved inventory control, others say it is misleading and they recommend to use inventory investment and this is what is Bechter and Stanley (1992) model did⁶.

⁴ Filardo used to methods; atheoretical method (VAR) and model-based method (Bechter and Stanley (1992)).

⁵ Those are subcomponents of the manufacturing sector.

⁶ For more details see Filardo (1995).

Chart 1. Aggregate inventory-sales ratio, 1959:1-2003:1)



3. Bechter and Stanley (1992) model

Bechter and Stanley used a partial stock-adjustment model. The model assumes that the amount of inventory investment that takes place in an economy in a given period of time, I_{it} , is the sum of desired (planned) inventory investment and unanticipated inventory investment. Desired inventory investment in time t is a fraction (s) of the difference between the desired inventory stock (I_d) at the end of the current period of time and actual inventory stock (I_a) at the end of the previous period. Unanticipated inventory investment in time t is a fraction (f) of the difference between sales (S_t) and expected sales (S_t^e). This means that inventory serves as a buffer stock against unseen demand shocks. The final version of the model for the purpose of estimation is as follows⁷:

$$I_u = a_0^* + b_0 S_t - s_0 I_{at-1} - f_0 S_t + e_t \quad (1)$$

⁷ For more details see Bechter and Stanley (1992).

All the variables as stated above. b_0 is the parameter that captures the inventory management behavior. This coefficient consists of the multiplication of two parameters ($b_0 = s_0 * i_0$); where s_0 is the speed-of-adjustment parameter. i_0 is the desired marginal inventory-sales ratio. f is the extent to which inventories serve as a buffer stock against unpredicted changes in sales. e_t is the error term. Significant inventory control means higher speed-of-adjustment and lower desired marginal inventory-sales ratio. The empirical estimation of this model requires estimating regression (1) over two sample periods and comparing the parameters between the two periods. The two sample periods are 1959:1-1982:3 and 1982:4-2001:1⁸. Comparison of parameter b_0 between the two periods tells us which parameter s_0 or i_0 has the larger effect. If parameter b_0 in the second period is greater than the one in the first period then we can tell that the raise in the speed of adjustment (s_0) is higher than the decline in the desired marginal inventory-sales ratio (i_0) and vice versa.

4. The Model Adjustment

In this part of the paper I am proposing an adjustment on the definition of inventory investment. This adjustment is consistent with the target of the inventory control technology i.e. just-in-time inventory (JIT). The JIT technique aims to minimize the inventory stock in all stages to reduce its cost by producing just in time to sell and purchasing just in time to produce. Therefore, JIT requires more rapid delivery and frequent orders of materials and supplies. Further, the parameters used to judge if we have a significant improvement in inventory investment or not are s_0 and i_0 which are the parameters of the desired inventory. Based on this information the adjustment on the original model comprises of; assuming inventory investment is just equal to the desired inventory investment as defined above. This means that the firms will not hold inventories for the purpose of a sudden increase in the sales. Furthermore, the original model assumes that the expected level of sales in period $t+1$ determines the desired stock of inventories for the end of period t . this means that

⁸ Those two periods are chosen because the adoption of the JIT by the U.S. firms started approximately at the beginning of the second sample.

we implicitly targeting higher sales within the desired inventory investment. Based on this modification, the estimated equation (1) will be as follows:

$$I_u = a_1^* + b_1 S_{t+1} - s_1 I_{at-1} + u_t \quad (2)$$

5. The Results

This paper tried to test the improved control hypothesis over eight kinds of inventories which they are; aggregate (TINV), nonfarm (NOFARM), farm (FARM), manufacturing (MINV), retail trade (RINV), wholesale (WINV), other and residuals. But the results were statistically significant for just only five kinds which they are: TINV, NOFARM, MINV, RTINV and WINV.

5.1.1 The Original Model

Table 2 shows the results of regression (1). The results reveal that the desired marginal inventories-sales ratio (i_0) declined for all kinds of inventories under study. But, the decline is disproportional; i.e. the desired marginal inventory-sales ratio for MINV declines from 1.08 to 0.62 from the first to the second period, while it declines for RTINV from 1.27 to 1.22. According to the speed of adjustment (s_0), it is clear that the speed of adjustment rises in most kinds of inventories, except for the MINV which is constant. In addition, the outcomes illustrate that the speed of adjustment vary from one kind of inventories to other. In sum, the evidence of this paper supports the idea that says the new inventory management has a significant effect on the behavior of inventory investment. Moreover, it confirms Bechter and Stanleys' result that is improved inventory control is obvious in some sectors more than others.

Table 2.Desired marginal inventory-sales ratio and speed of adjustment. *Original Model*⁹

	1959:1 – 1982:3				1982:4 – 2001:1			
	b_0	s_0	i_0^{10}	f_0	b_1	s_1	i_1	f_1
TINV	0.25	-0.24	1.07	-0.26	0.25	-0.29	0.87	-0.41
NOFARM	0.28	-0.22	1.26	-0.31	0.31	-0.32	0.96	-0.43
MINV	0.23	-0.21	1.08	-0.33	0.13	-0.21	0.62	-0.23
WINV	0.25	-0.16	1.56	-0.45	0.73	-0.56	1.30	-0.50
RTINV	0.12	-0.10	1.27	0.37	0.27	-0.22	1.22	-0.61

5.1.2 The Adjusted Model

Table 3 shows the results of regression (2). The results illustrate that the desired marginal inventory-sales ration has exactly the same behavior as in the original model. The main difference compare to the original model is that the speed of adjustment increases more. This means that if the firms do not pay attention to holding inventories as a buffer stock it will be able to adjust its inventories faster to be consistent with its desired inventories. In Sum, the conclusion of this section supports the conclusion reached by section 5.1.1.

Table 3. Desired marginal inventory-sales ratios and speed of adjustments.*Adjusted Model*¹¹

	1959:1 – 1982:3			1982:4 – 2001:1		
	b ₀	s ₀	i ₀	b ₁	s ₁	i ₁
TINV	0.17	-0.16	1.08	0.42	-0.45	-0.93
NOFARM	0.20	-0.16	1.27	0.49	-0.49	-1.00
MINV	0.16	-0.14	1.11	0.23	-0.37	-0.62
WINV	0.18	-0.11	1.58	0.63	-0.48	-1.31
RTINV	0.40	-0.30	1.35	0.25	-0.20	-1.24

⁹ All the estimated parameters have statistically significant t statistics.

¹⁰ $i_0 = (b_0 / s_0)$.

¹¹ All the estimated parameters have statistically significant t statistics

6. Conclusions

This paper showed that the improved inventories technique i.e. JIT adopted by most U.S. firms in the beginning of 1980 has a significant impact on inventory investment behavior. Further, this paper proved that this improvement distributed disproportionately among the different inventory's sectors. Moreover, the paper showed that the speed of adjustment of the firms would be faster if the firms ignore holding inventories as a buffer stock.

References

Allen, Donald S. (1995) "Change in Inventory Management and the Business Cycle," Federal Reserve Bank of Saint Louis Review, July/August.

Bechter, Dan M. and Stephen Stanley. (1992) "Economic Stability in the 1990s: The Implications of Improved Inventory Control," Business Economics January.

Blinder, Alan S. and Louis J. Maccini. (1991a) "Taking Stock: A Critical Assessment of Recent Research on Inventories," The Journal of Economic Perspectives, Vol. 5, no. 1, Winter 1991.

Blinder, Alan S. (1990) Inventory Theory and consumer Behavior, Ann Arbor, Michigan: University of Michigan Press.

Christiano, Lawrence J. (1988) "Why does inventory investment fluctuate so much," Journal of Monetary Economics, Vol. 21, March/May.

Filardo, Andrew. (1995) "Recent Evidence on the Muted Inventory Cycle," Federal Reserve Bank of Kansas City Economic Review, second quarter.

Fitzgerald, Terry J. (1997) "Inventories and the Business Cycle: An Overview," Federal Reserve Bank of Cleveland, Economic Review, Third Quarter.

Huh, Chan. (1994) “Just-in-Time Inventory Management: Has It Made a Difference?” Federal Reserve Bank of San Francisco, FRBSF Weekly Letter, Number 94-18, May 6.

Little, Jane Sneddon. (1992) “Changes in Inventory Management: Implications for the U.S. Recovery,” Federal Reserve Bank of Boston New England Economic Review November/December.

McCarthy, J. and E. Zakrajsek (2003), “Inventory Dynamics and Business Cycles: What Has Changed?”

Morgan, Donald P. (1991) “Will Just-In-Time Inventory Techniques Dampen Recessions?,” Federal Reserve Bank of Kansas City Economic Review, March/April.

Stock, J. H., and M.W. Watson (2002), “Has the Business Cycle Changed and Why?,” Forthcoming NBER Macroeconomic Annual.